REMARKS

Claims 3, 7-12 and 14-29 are currently pending in this application. Claims 7-9 are independent claims.

In the current Office Action dated September 9, 2004, the Examiner continues to maintain the rejection of all of the pending claims, with the Gilleo et al. patent now being relied upon in addition to the prior art references previously cited. Specifically, claims 3, 7-9, 11-12, 16-17, 19, 22-24 and 27-29 stand rejected under 35 U.S.C. §103(a) as being obvious over the base combination of Chakravorty (U.S. Patent No. 6,181,569), Honda et al. (U.S. Patent No. 6,181,569) and Gilleo et al. (U.S. Patent No. 6,194,788). Claims 10, 14-15, 18, 20-21 and 25-26 stand rejected over the base combination and further in view of Teranuma et al. (U.S. Patent No. 6,392,217), Tsukagoshi et al. (U.S. Patent No. 6,113,728) and Komiyatani et al. (U.S. Patent No. 6,447,915). These rejections are respectfully traversed.

In the various embodiments disclosed in the present application, a sheet of encapsulating material is heated by heat that is generated by a heating apparatus after setting the sheet on a semiconductor wafer that has already been placed on the heating apparatus. In other words, the sheet is heated by heat that is applied through the wafer (see, for example, Figure 2 of the application). This method advantageously allows the sheet to be heated and cured gradually, assuring the elimination of voids, and advantageously ensures complete encapsulation without the need for application of pressure (see for example, page 12, lines 12-15, and page 12, line 20 through page 13, line 5).

By contrast, Chakravorty fails to disclose that a sheet of encapsulating material is heated and cured by heat that is generated by a heating apparatus and that is applied through a wafer placed on the heating apparatus, as amended claims 7-9 require. What Chakravorty shows is several encapsulation methods. In one, the wafer is placed in a mold, and a fluid mold compound is injected into the mold under pressure and cured at an elevated temperature (Chakravorty column 10, lines 8-22). A second method disclosed in Chakravorty involves bonding a dry polymer film, coated with an epoxy adhesive, to a wafer by application of pressure and heat (Chakravorty column 10, lines 28-45). Chakravorty further discloses a third encapsulation method in which a coating

of a polymeric film is applied from its liquid solution and then baking the coating dry (Chakravorty column 10, lines 46-65). Each of these methods differs in some material respect, and fails to offer the simplicity of the claimed method.

Honda shows an epoxy resin composition film 2 (Figures 1-3) particularly suitable for bonding a semiconductor chip to a substrate. One typical procedure disclosed in Honda for using the film involves cutting the laminate film to a suitable size, moderately pressing the film to a substrate, mounting a chip on the film, and applying heat and pressure to the assembly (Honda column 12, line 67 through the column 13, line 3). Thus, Honda, like Chakravorty, fails to teach or suggest heating the epoxy resin composition film by heat that is generated by a heating apparatus and is applied through a wafer placed on the heating apparatus.

Teranuma discloses the use of an anisotropic conductive adhesive 5 to bond substrates 1 and 2 together (Teranuma Figure 1). In Teranuma, bonding is performed in an autoclave device upon the application of heat and pressure (Teranuma Figure of 2(c), and column 12, lines 3-12). Teranuma fails to disclose that a sheet of encapsulating material is heated and cured by heat that is generated by a heating apparatus and that is applied through a wafer placed on the heating apparatus, as amended claims 7-9 require. The other cited references, Tsukagoshi and Komiyatani also fail to disclose the claimed method.

In the office Action, the Examiner acknowledges that neither Chakravorty nor Honda disclose the specific method of applying heat to the sheet of encapsulating material as presently claimed. To address this deficiency in the Chakravorty and Honda references, the Examiner points to Gilleo as disclosing heating of a preform by direct heating of the wafer to heat the preform on the wafer surface (column 5, line 50 through column 6, line 13). The Examiner argues that it would have been within the scope of one of ordinary skill in the art to employ the method of Gilleo according to its disclosed intended purpose to enable heating of the encapsulant layer suggested by combination of the teachings of Chakravorty and Honda.

The text in Gilleo to which the Examiner refers, discusses the bonding of an underfill material, cast in the form of a film, to the surface of a wafer by the application of heat and pressure, and then drying the coating by heating in an oven or by direct

heating of the wafer. However, it is respectfully submitted that the Examiner has impermissibly picked this particular feature from the prior art without considering what the Gilleo reference as a whole fairly suggests to one of ordinary skill in the art. For example, the film being applied in Gilleo is not an encapsulant, *per se*, but rather an underfill coating that is intended to melt when chips to which it is applied are mounted to a substrate by reflowing the solder bump connections on the chips in a multi-zone oven (see generally, column 6, lines 35-65). The underfill coating is formed on a release paper which must withstand the heating of the underfill coating and be removed prior to curing (column 5, lines 51-52). The <u>curing</u> of the underfill coating in Gilleo does not take place in conjunction with the <u>heating</u> of the coating on the wafer, as the present claims require, but rather at a later time when the wafer has already been diced and the individual chips are being mounted to a substrate (column 6, lines 55-60). The purpose of the initial mild <u>heating</u>, to which the Examiner refers, is to cause the film of underfill material to melt and bond to the wafer <u>without</u> activating the fluxing properties or causing polymerization (column 5, lines 56-58). This initial heating is done in conjunction with the application of pressure. Gilleo fails to teach or suggest the application of <u>reduced</u> pressure lower than atmospheric pressure, for a period of time sufficient for the elimination of voids, as specifically required by claims 8 and 9. The later <u>curing</u> of the underfill material in Gilleo is not accomplished "by application of heat to said semiconductor wafer by a heating apparatus on which said semiconductor is placed," as the independent claims recite, but rather in a multi-zone oven (column 6, lines 45-47 and 55-60). Further, the coating in Gilleo preferably covers the solder bumps because it offers fluxing properties as well as underfill properties (column 5, lines 61-64), while the claimed invention specifically includes the step of polishing the encapsulating resin layer to expose portions of the bumps.

In short, the process disclosed in Gilleo is directed to the application of an uncured underfill coating having fluxing properties to a semiconductor wafer, and is significantly different from the present invention. Accordingly, the Applicant respectfully submits that the prior art relied upon would not suggest to one of ordinary skill in the art the desirability of the modification proposed by the Examiner. Even if the teachings of the references were combined, it is submitted that such combination

would not result in the claimed invention.

The Examiner is also kindly requested to reconsider the arguments regarding the references made by the Applicant in the Request for Reconsideration submitted on July 28, 2003, which, in the interest of brevity, is incorporated herein by reference.

Based on the foregoing, it is respectfully submitted that independent claims 7-9, as well as dependent claims 3, 10-12 and 14-29, patentably distinguish over the applied prior art references, whether considered individually or in combination. Allowance of the pending claims and passing of the application to issue are earnestly solicited.

Respectfully submitted,

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